

not what Mr. Wilson does, and the consequences of his procedure are very instructive, especially from the point of view of absolute geometry. He practically confines himself to rectilineal figures, and reciprocates segments into angles, thus introducing metrical elements, and becoming necessarily faced by the complications which they involve. It is now familiar to pure mathematicians that, with an "absolute" conic to define our metrical system, there is a consistent and reciprocal definition of *angle* and *segment* (or *distance* of two points) by which each of these is the product of a constant and the logarithm of a cross-ratio. But to identify these with the expressions for angle and segment obtained by elementary methods with rectangular coordinates it is necessary to suppose the absolute conic to degenerate into one which, considered as a point-locus, is the line at infinity counted twice, and considered as an envelope is the pair of circular points at infinity. This complicated character of the absolute is at the base of all the puzzling difficulties which beset such attempts as this of Mr. Wilson's—difficulties, it is true, which he often surmounts in an ingenious manner.

For example, in the appendix he introduces a system of angular coordinates, both for lines and points, and obtains point and line equations for the ellipse. Now the unmistakable drift of his thought is that if point and line can be defined by coordinates which measure segments, then "reciprocally" line and point can be determined by coordinates which measure angles. But his angular coordinates are not really reciprocal to the segmental coordinates, as is clear from the fact that his equation of the ellipse is trigonometrical and not algebraical. It might be interesting to decide whether any simple functions of Mr. Wilson's angular coordinates are the direct reciprocals of the ordinary Cartesian segmental coordinates.

A remark should also be made on the note (pp. 120-6) on the most general form of the construction of reciprocal figures, as it may prevent possible misunderstanding. In the ordinary process of reciprocation with an auxiliary conic, F and F' being the corresponding figures, we may say that F' is derived from F by a process, or rule, of polarising, and that F is derived from F' by the same rule. Mr. Wilson gives an example in which F' is derived from F by one process, and F from F' by another— F and F' being reciprocal in the general sense of projective geometry. He adds that this is "wider than the usual method," which, of course, it is, if "the usual method" means employing an auxiliary conic. But the figures obtained by his method can be constructed each from the other by the general method of making four points (or lines) in F correspond at pleasure to four lines (or points) in F' , and then to every linear way of constructing F' from F there is a dualistically corresponding way of deriving F from F' . So that it must not be supposed that Mr. Wilson has discovered any essentially new way of constructing reciprocal figures, though his remark might be misunderstood in that sense.

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To return to the more popular aspect of this interesting book. The figures are, strictly, strips of black on a white ground. For the author they represent geometrical lines, and are reasoned upon as such. But the reader may give them different interpretations, and make up problems for himself accordingly. For example, let the lines in a diagram represent cuts made in a single piece of wood by a fret-saw; how many pieces are produced? What is the simplest wire model that will give a shadow like a given diagram? and so on. Stencilling, again, is full of problems analogous to those which Mr. Wilson discusses; knitting and netting give any number of examples of single-path figures. The proverb that "extremes meet" is curiously illustrated by these purely topographical questions, which suggest puzzles for children, problems for designers, and tools for logicians; while they appear with startling unexpectedness in the most abstruse mathematical theories—Abelian functions, group-theory, hydrodynamics, and electricity.

G. B. M.

ORGANIC PREPARATIONS AND THE COAL-TAR COLOUR INDUSTRY.

The Synthetic Dyestuffs and the Intermediate Products from which they are derived. By J. C. Cain and J. F. Thorpe. Pp. xiv+405. (London: Chas. Griffin and Co., Ltd., 1905.) Price 16s. net.

THE publication of this work is not without significance in its bearing on the oft-repeated statement that the great industry represented by the manufacture of coal-tar dyes is decaying almost to vanishing point in this country. The fact of publication presumes a demand which, in this case, must be mainly confined to those connected with, or training for, the manufacture referred to. It is unlikely that any great number of students in the colleges of this country are preparing for positions in colour works abroad, and it is therefore reasonable to assume that those concerned with the production of the book have satisfied themselves that the industry is not in such a parlous state as pessimists would have us believe. In any event, the book will powerfully influence one factor in the case—the proper instruction of students who are training for the industry.

Whether this touches the root of the matter is, however, doubtful. The gradual decline in importance of the manufacture of coal-tar products in this country has been variously ascribed to the deficient training given in the colleges, the bad patent laws, and the cost of alcohol, relatively to the conditions existing in Germany with regard to these matters. Concerning the work of the colleges, it is now generally conceded that the best of our schools of organic chemistry need fear no comparison with those abroad. The effect of our patent laws, both past and present, in handicapping the industry, has doubtless been very great; but possibly the inquiry of a Royal Commission, such as recently reported into the question of industrial alcohol, would show that, as has been conclusively proved with regard to the cost of alcohol, the effect of the patent laws on the non-

development of the English coal-tar colour industry has really been much less than has been supposed. A cause fundamental to those enumerated above, and lying at the basis of many other of our industrial lapses, may be defined as the lack of an appreciation of the importance of science on the part of the public generally. This has rendered the development of many industries quite impossible. It is reputably stated that the Badische Anilin- und Soda-Fabrik spent upwards of one million pounds sterling during a period extending over twenty years in solving the industrial problem of the synthesis of indigo. What English board of directors, even if themselves satisfied to do so, would venture to spend any such sum on apparently unproductive scientific experiments? Public opinion in this country, as reflected in the shareholders, would not allow it, any more than a six or seven years' college science course is considered a paying investment. Nor will satisfactory reform of the patent laws and the excise laws come about until the Government is made to realise, by the pressure of public opinion, that the future of the national industries largely depends upon the proper utilisation of scientific fact and method.

The work under review consists of three parts and an appendix. Part i. comprises a description of the various synthetic dyestuffs and the intermediate products from which they are derived. Part ii. gives methods for preparing typical products on a laboratory scale, but as far as practicable by works processes; and part iii. deals with the analysis and identification of dyes and with the detection of dyestuffs on the fibre. The appendix contains tables giving the specific gravities of various solutions.

The first chapter of the book gives a very short account of coal-tar and the separation and purification of benzene, naphthalene, anthracene, and phenol. A little more space might usefully have been devoted to this section.

Subsequent chapters deal with the nitration and sulphonation products of the hydrocarbons, and the production and properties of amido, hydroxyl, and carboxyl derivatives. The second section of part i. gives in seventeen chapters, occupying about one-third of the book, a systematic description of the various groups of dyes, the classification being, of course, based on the chemical constitution, and not upon the mode of application, of the dyes. The treatment of this section is excellent, the descriptions being very lucid and sufficiently exhaustive without too much detail.

Part ii., which deals with the preparation of colouring matters and intermediate products, is at once the most novel and the most useful feature of the book. It is evidently the outcome of much personal experience on the part of the authors, and the limitations of ordinary college laboratories have very sensibly been kept in view; though at the same time only such materials are employed as would be used in the technical preparation of the several products in the works.

Perhaps the least satisfactory portion of the book is the chapter dealing with the application of the

colouring matters. It is very doubtful whether any useful purpose is served by such a short treatment of the science of dyeing as can be compressed into thirteen pages. Condensation to this extent inevitably results in misleading generalisation, and the authors would probably have been well advised to have referred their readers to some of the well known treatises on dyeing for this part of the subject.

The chapters on the valuation and analysis of dyes are to some extent open to the same criticism. As an example of their deficiencies, the method given for the analysis of indigo may be referred to. The method described would be entirely untrustworthy if applied to the estimation of natural indigos, and such is evidently the intention. In its main and essential sections, however, the book is a noteworthy addition to the literature of specialised organic chemistry, and both authors and publishers are to be congratulated on its production.

WALTER M. GARDNER.

SCIENCE AND MYSTICISM.

Prinzipienfragen in der Naturwissenschaft. By Max Verworn. Pp. 28. (Jena: Gustav Fischer, 1905.) Price 80 pf.

PROF. VERWORN detects mystical murmurs in the scientific camp, and is full of apprehension of coming dangers, for "mysticism is the negation of scientific thinking." Naturalists have been working out a monistic interpretation of the world, but there have been symptoms of faint-heartedness lately, especially before two questions, which the author states in the following terms:—Do vital processes depend on the same principles as the processes in inanimate nature? Are psychical processes referable to the same principles as those on which bodily processes depend? Verworn assures us that both these questions may be confidently answered in the affirmative, for the world is one, with the same principles, or rather with one principle throughout. What that "principle" is we have not been able to discover from the lecture, but we are assured that it is not a "mystical principle."

In regard to the first question, Prof. Verworn says that when we sufficiently analyse the criteria of life we find none requiring other principles than those which we require in interpreting the inorganic world. The only feature distinctive of life is the combination of potencies which are seen separately apart from life. Chemical ferments illustrate metabolism without growth; the condensations and polymerisations of chemical compounds illustrate growth without metabolism; the organism combines both. How it does so we are not told, but it is not by any peculiar vital principle. There is no need to assume a secret "organisation" transcending physical and chemical principles; there is no warrant for postulating a persistent protoplasmic architecture, either microscopic or molecular, as the physical basis of life; the form and structure of a cell is just like that of a fountain or a flame; life is a flux; "*Πάντα ρεῖ*" is true throughout nature. To suppose, as Driesch, for instance, does, that an Aristotelian "entelechy" resides in